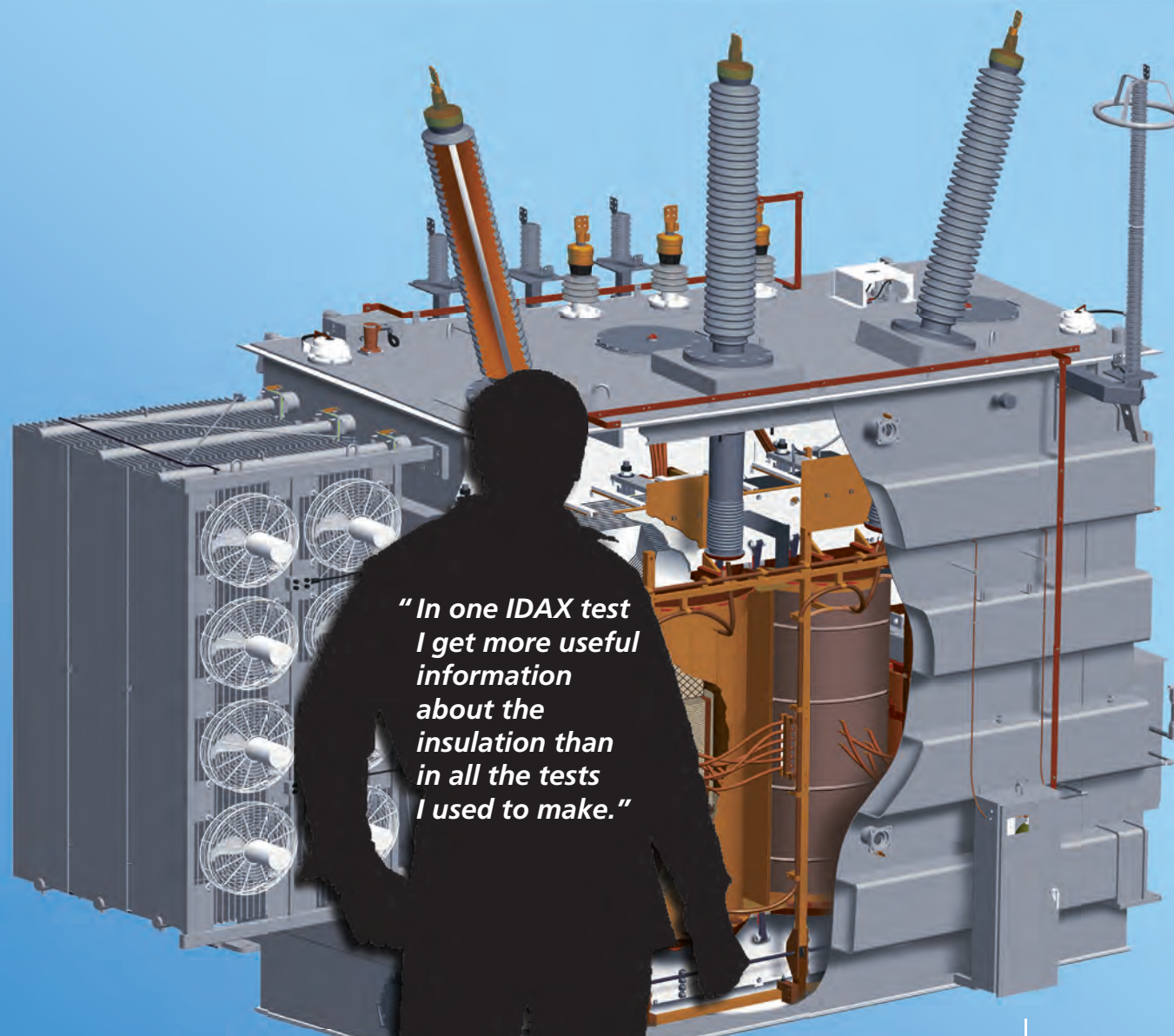


IDAX 300/350

Insulation Diagnostic Analyzers



*"In one IDAX test
I get more useful
information
about the
insulation than
in all the tests
I used to make."*



Easy

Reliable

Fast

Complete

Megger[®]

Safe and sound

Knowing the condition of the insulation

Knowing the transformer insulation condition gives the correct input for risk assessments and asset management. High moisture content accelerates the aging of the paper insulation, thus reducing transformer life. Dielectric response measurement is a cost- and time-effective method to determine the transformer health, including the moisture content of the oil/paper insulation system.

Traditionally insulation assessment is done by measuring tan delta/power factor at mains frequency 50/60 Hz. This is however of limited value. As an example, transformers may have the same tan delta/power factor at power frequency but one may be wet with good oil and considered for a dry-out while another may be dry but the oil should be conditioned or regenerated. Dielectric frequency response (DFR/FDS) diagnostic test will give you accurate and conclusive information. Such data is essential in prioritizing the maintenance of your transformer fleet and making sure your assets will reach and exceed their expected service life.

High moisture in the transformer insulation leads to the well-known issues of the effects of water on:

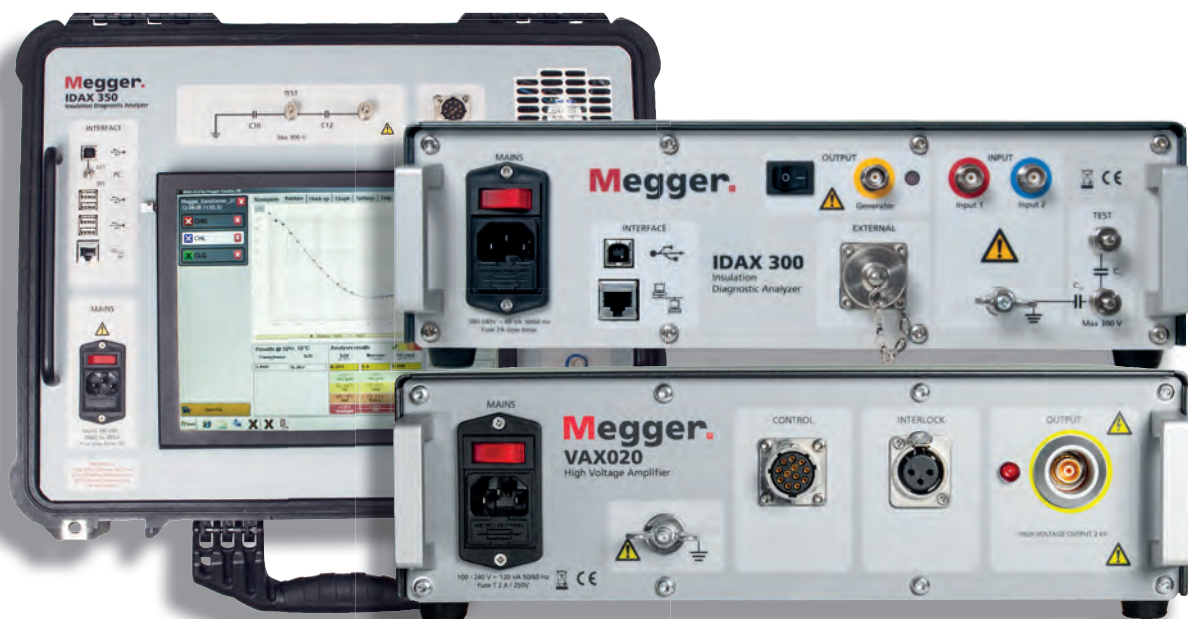
- **Loading capability** – Limits the loading capability due to decreased bubbling inception temperature
- **Dielectric strength** – Decreases the dielectric strength of the oil and decreases PD inception voltage
- **Aging** - High temperature and moisture will dramatically accelerate aging that lowers the mechanical strength of the cellulose insulation

For a good life management of transformers, the moisture content of the insulation should be retained at low concentrations. Transformers are dried during the manufacturing process until measurements or standard practices would yield a moisture content in the cellulosic insulation of typically less than 1%. After the initial drying, the moisture content of the insulation system will continually increase. There are several sources of excessive water in transformer insulation:

- **Residual moisture not removed in the factory dryout process**
- **Moistening of the insulation surface during assembly and/or maintenance**
- **Moisture ingress from the atmosphere (gasket leaks, breathing during load cycles, site erection process)**
- **Aging/decomposition of cellulose and oil**

It is important to understand that the moisture in the transformer mainly resides in the solid insulation. Typically more than 99% of the moisture in the transformer reside in the cellulosic insulation.

Knowing the moisture content is essential information for the transformer owner whether it is confirming a dry transformer at commissioning or assessing an older unit to see if there is a need for preventive or reactive measures.



The IDAX system family of products offers units with or w/o internal computer.

A separate (optional) high-voltage amplifier extends the test voltage from 200 to 2 kV (peak).

Accessory kit provides adapters, tools and cables for bushing and oil tests.

All-in-all it makes IDAX the most complete test set for insulation diagnostics.

To measure is to know

Test technique based on knowledge and experience

Easy

The test is easy. Connect three cables, enter the insulation temperature and start the test. When the test is finalized, the data is automatically analyzed and presented.

Other features that make the tests easier:

- Tests can be done at any temperature without worrying about temperature correction.
- Connection diagrams for different measurement objects and setups help to perform repeatable and reliable tests.
- Standardized connections; generator, red, blue and ground.
- Software that helps to understand the condition of the insulation. Assessments limits based on international standards and guides.

Fast

Measuring dielectric response at very low frequencies takes time. In the new IDAX, this issue is addressed by introducing a new and unique method where the test signal at low frequencies contains a combination of frequencies. This method significantly reduces the measurement time in the low frequency range and consequently the total measurement time.

As an example, an IDAX measurement down to 1 mHz takes now only about 22 minutes, the fastest DFR test available. Without compromising the accuracy and reliability in the frequency domain measurement technique.

Reliable

All IDAX instruments use advanced noise suppression technique for reliable results in live substation environments with high interference.

The interference levels are often significant and may cause large measurement errors if not handled correctly. IDAX can handle up to 1 mA interference and with the VAX020 high-voltage amplifier up to 10 mA at 1:10 signal-to-noise

ratio. This secures reliable DFR measurements under the most severe interference conditions.

Using true frequency domain measurements for dielectric response has major advantages:

- High AC (power frequency) interference suppression capacity
- High DC and VLF interference suppression capacity
- No concerns for long-time discharge of test object between measurements

Complete

The IDAX instruments support a wide range of applications for insulation testing.

Typical test objects:

- Power transformers
- Bushings
- Instrument transformers (CT/VT)
- Motors and generators
- General oil-paper insulation

Measurements:

- Tan delta/power factor and capacitance
- Dielectric frequency response
- Excitation current
- Hot-collar testing
- DC insulation

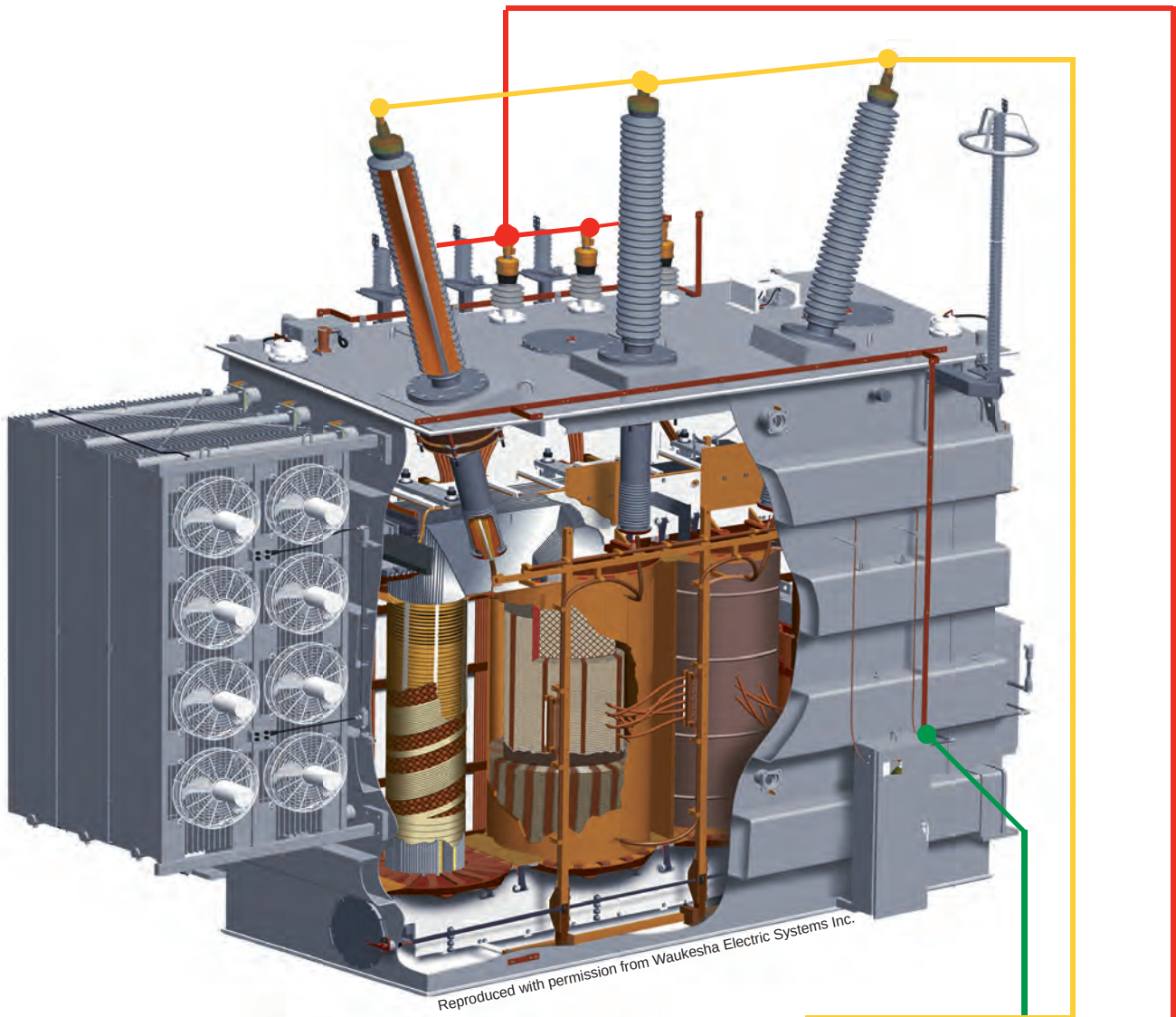
Analysis/insulation assessment:

- Moisture in cellulose
- Conductivity/dissipation factor of insulating liquid
- Individual temperature correction of tan delta/power factor
- Temperature dependence of tan delta/power factor
- Polarization index
- Dielectric absorption ratio



- ✓ **Time saving method**
Multi-frequency technique for shortest measurement time
- ✓ **Temperature independent diagnosis**
Wide frequency range and advanced modeling technique facilitate precise results independent of temperature
- ✓ **Wide application area**
Can perform insulation diagnostics of many HV assets in the power system
- ✓ **High interference immunity**
Fast and accurate measurements in high interference environments

Simple hook-up and automatic analysis



Reproduced with permission from Waukesha Electric Systems Inc.

IDAX measures and analyzes the dielectric response of the transformer to determine the moisture content in the paper insulation.

The method is based on modeling of the insulation as described in international publications and standards e.g. CIGRE TB 254, 414 and 445 and IEEE C57.152.

The analysis is automatic, only the insulation (oil/winding) temperature has to be entered.



Easy measurements

Dielectric response measurements are performed the same way as traditional tan delta/power factor measurements at power frequency using the same test modes; UST, GST, GST-guard etc. As an example, moisture in the solid insulation of a two-winding transformer is measured by:

- Connecting test ground to transformer tank/ground
- Connecting generator signal to HV bushings
- Connecting measure Red to LV bushings

After entering the insulation temperature (oil/winding temperature) the test is started. After the measurement is finalized, the data is automatically analyzed and the insulation is assessed as:

- Power frequency capacitance and tan delta/power factor at 20°C reference temperature
- Moisture in solid insulation
- Oil conductivity/dissipation factor at 25°C reference temperature

All in one test, neither waiting for moisture equilibrium nor taking oil samples and using test cells.

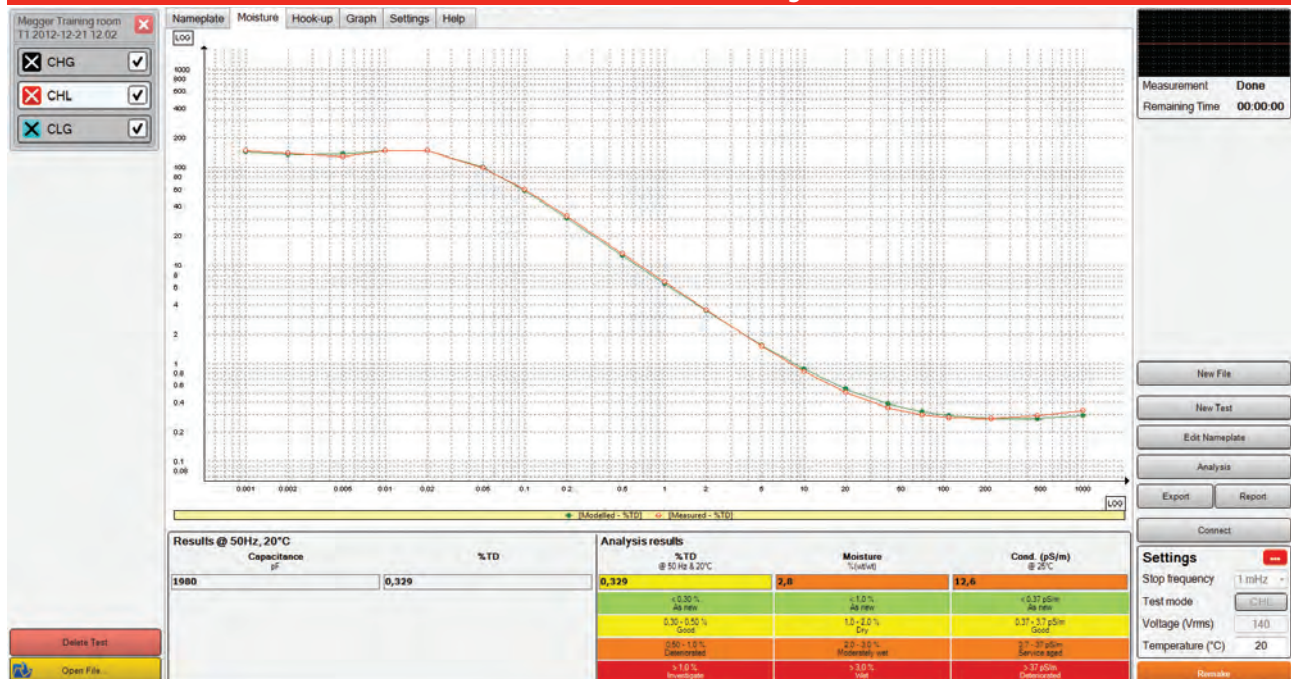
Faster measurements

The first IDAX model was released 1997 and was the first test set for performing DFR field testing. Since then, IDAX instruments and the DFR methodology have been used by numerous customers all over the world. The methodology and technique have been refined over the years and the 5th generation IDAX is the most versatile DFR instrument on the market. As an example, IDAX is using a multi-frequency technique for measuring the lowest frequencies giving that an IDAX measurement down to 1 mHz takes now only about 22 minutes. And this without compromising the advantage of using frequency domain measurement technique.

Three channel measurements

All IDAX instruments have three measurement terminals for multiple tests without changing cable connections. IDAX 350 and the extended version of IDAX 300 (IDAX 300S) have dual separate ammeters, allowing two completely independent measurements simultaneously. This feature reduces measurement time substantially, especially when measuring transformers with a tertiary winding.

Moisture assessment with IDAX is fast and automatic – Direct readings of moisture in solid insulation



Temperature corrected 50/60 Hz tan delta/power factor and oil conductivity/dissipation factor



✓ Fast

Measurements with IDAX are fastest on the market

✓ Easy

Hook-up is done with three cables and test is automated

✓ Automated analysis of:

Moisture content

Temperature corrected tan delta/power factor

Temperature corrected oil conductivity/dissipation factor

Complete

A DFR/FDS test set with extended functionality



The IDAX 350 has a built-in computer but can also be used with an external PC.

Multi-function test set

IDAX is a multi-function test for testing transformers, bushings and other power components. With IDAX you can do:

- Dielectric frequency response measurements
- Power frequency tan delta/power factor and capacitance measurements
- Excitation current measurements
- Hot collar testing
- DC insulation testing (insulation resistance, polarization index and dielectric absorption ratio)
- Tip-up/step voltage testing

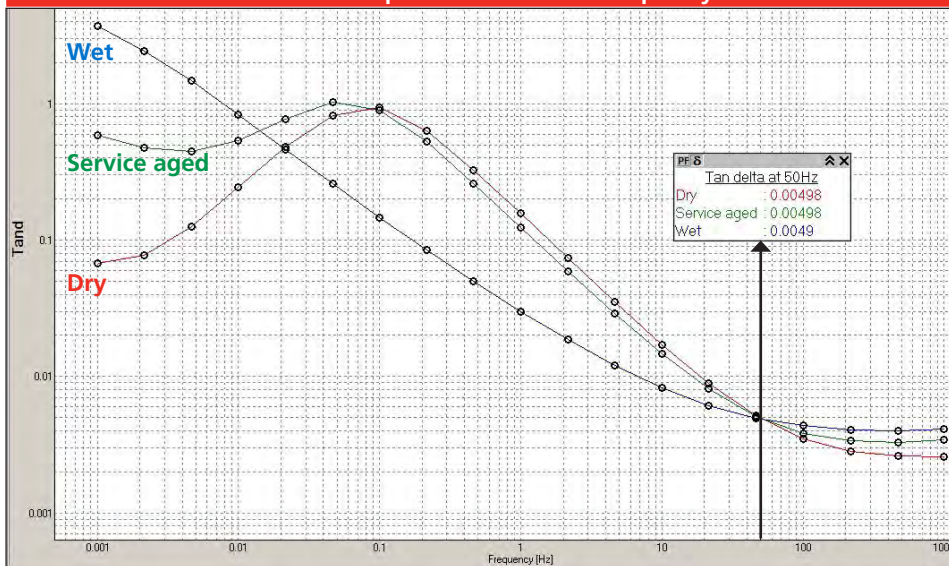
Dielectric frequency response measurements

Dielectric frequency response measurements as described in international publications and standards e.g. CIGRE TB 254, 414 and 445 and IEEE C57.152 can be used to determine the moisture content in paper insulation and also to estimate the temperature dependence of tan delta/power factor. All IDAX instruments are performing DFR measurements with AC test signals for securing reliable results in live substation environments with high interference. Moisture and insulation assessment is automatic; only the insulation (oil/winding) temperature has to be entered.

Tan delta / power factor and capacitance measurements

Tan delta/power factor and capacitance measurements at power frequency are commonly used for characterization of insulation at manufacturing as well as for field diagnostics. IDAX uses synthesized AC test signals for reliable results independent of the power quality. With the VAX020 high voltage amplifier tan delta/power factor testing can be performed at 1.4 kVRMS on test objects up to 80 nF (50 Hz).

Tan delta for three transformers plotted at variable frequency



Three transformers having the same tan delta/power factor (0.5%) at mains frequency.

One is wet, 3.3% moisture, but the oil is good with low conductivity (1 pS/m).

Another is dry, 0.5% moisture, but the oil is close to the limit for service aged conditions (29 pS/m).

The third transformer is a typical older/service aged transformer with 2% moisture and an oil conductivity of 22 pS/m.

Maintenance strategies could be different for all three transformers but this is not possible to see if diagnostics is based only on 50/60 Hz tan delta/power factor testing.

High-voltage measurements

VAX020 is a high-voltage amplifier that extends the IDAX test voltage range from 200 V to 2 kV. This improves the capability to perform accurate measurements on low capacitance objects, e.g. bushings and instrument transformers in high interference environments. IDAX itself is designed for field use in substation environment and with its AC measurement technique it is resistant to high electrical interference. With VAX020 high voltage amplifier the capability to withstand interference conditions is further increased and allows to measure any transformer or bushing correctly even under the most severe interference conditions, e.g. in HVDC substations.

In addition, VAX020 is giving the user the capability of performing high-voltage measurements for e.g. DC insulation, tan delta/power factor, excitation current and hot-collar testing.

DC measurements

Besides AC DFR/FDS measurements, IDAX can also perform DC insulation measurements at up to 2 kV test voltage (with the optional VAX020 amplifier). The polarization current is measured over time and the following parameters are automatically calculated and displayed:

- Insulation Resistance (IR60)
- Dielectric Absorption index (DAR)
- Polarization Index (PI)

Note: Polarization index, PI, was introduced to detect moisture in the winding insulation of rotating machines. For the complex oil-cellulose insulation system of transformers the PI results can be misinterpreted and the polarization method should not be used to assess insulation condition in new power transformers. Polarization index for insulation liquid is always close to 1. Therefore, the polarization index for transformers with low conductivity liquids (e.g. new mineral oil) may be low in spite of good insulation condition. DFR/FDS/PDC measurements are preferred for quantitative assessments of the moisture in the insulation (CIGRE TB 445 "Guide for Transformer Maintenance" and IEEE C57.152-2013 "IEEE Guide for Diagnostic Field Testing of Fluid-Filled Power Transformers, Regulators, and Reactors")



IDAX 300 (here controlled by an external PC) is a powerful tool for condition assessments of power transformers.

Excitation current measurements

Excitation current measurement is a standard test for transformers to detect core and winding defects. IDAX300/350 performs excitation current measurements at power frequency at up to 1.4 kV test voltage (with optional VAX020 amplifier). Results are presented as excitation current and inductance for the selected test voltage.



- ✓ **Multi-function test set**
DFR/FDS, tan delta/power factor and capacitance, excitation current and DC insulation measurements in one multi-function instrument
- ✓ **Multiple insulation assessment in one go**
Temperature corrected tan delta/power factor, moisture and oil assessment in one test
- ✓ **High interference suppression capacity**
AC technique secures reliable measurements under the most severe interference

Analysis models according to international standards

How does it work

Assessing reliable moisture content in transformer insulation based on oil sample tests is unreliable as the water migrates between the solid insulation and oil as temperature and/or transformer load changes. An oil sample for moisture analysis has to be taken at relatively high temperature and when the transformer is in equilibrium. Unfortunately, this is a rare state for transformers, thus resulting in unreliable assessments. Experience has shown that this method tends to overestimate the amount of water in the insulation.

The dielectric response method, in contrast, is a very reliable method providing a high degree of accuracy in assessing the moisture content in the paper insulation.

IDAX derives the moisture content in paper or pressboard from the measured dielectrical properties. The dissipation factor plotted against frequency shows a typical shape shown below. With increasing temperature the curve shifts towards the higher frequencies. Moisture influences the low and the high frequency areas. The linear, middle section of the curve reflects oil conductivity. Insulation geometry conditions determine the "knee points," which are located to the left and right side of the steep gradient.

IDAX moisture determination is based on a comparison of the transformers measured response to a modeled dielectric response. The insulation model is the internationally recognized X-Y model described in e.g. CIGRE TB 254 and 414. The insulation duct between the LV and HV windings of the transformer is reduced to a single capacitor where the dielectric materials consist of cellulose and oil.

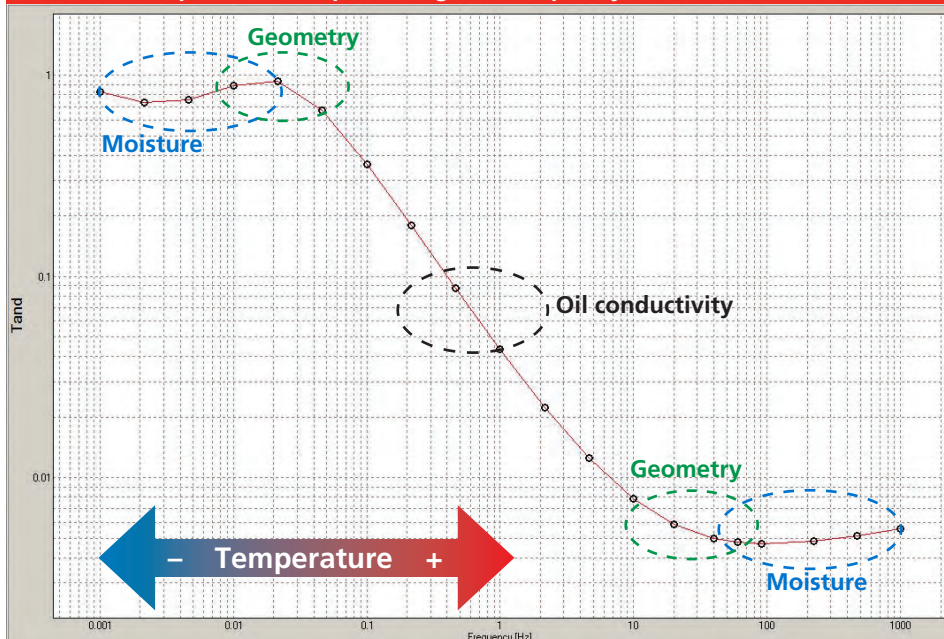
The single capacitor can be analytically described. A matching algorithm compares the model data with the measured data and adjusts the dielectric response of the single capacitance until a best fit with the measured response from the transformer is achieved. From the modeled response, moisture in the cellulose material and oil conductivity/dissipation factor is determined as well as temperature dependence of the dissipation factor. Only the insulation temperature (oil/winding temperature) needs to be entered as an input parameter.

Schematic diagram of transformer insulation



Basic structure of the insulation duct seen from above and its XY representation.

The tan delta / power factor plotted against frequency



The tan delta/power factor plotted against frequency shows a typical shaped curve.

With increasing temperature the curve shifts towards the higher frequencies.

Moisture influences the low and the high frequency areas.

Oil conductivity/dissipation factor determines the response in the mid-frequencies.

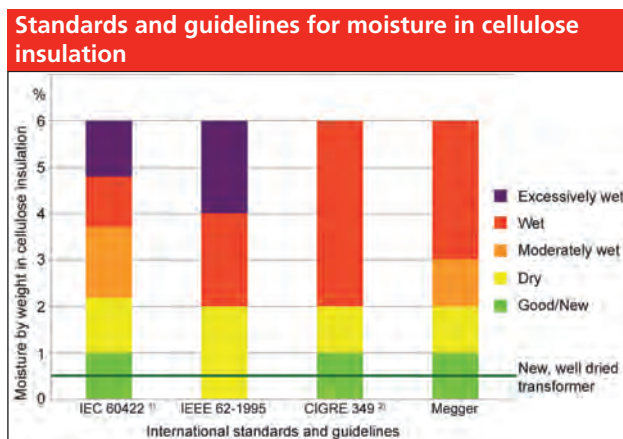
High interference suppression capacity

How to assess the results

Several international standards, guides and reports are giving guidelines for insulation assessment in terms of power frequency tan delta/power factor at 20°C, moisture content in solid insulation and conductivity/dissipation factor of oil. The insulation assessment in IDAX provides results and categorization for tan delta/power factor of the whole insulation system at 20°C, moisture in cellulose and oil conductivity/dissipation factor at 25°C, giving the user a thorough description of the insulation condition.

Guidelines for oil conductivity/dissipation factor at 25°C is according to IEEE C57.152-2013. For power frequency tan delta/power factor at 20°C the assessment limits are based on "industry practice" and guidelines in CIGRE TB 445 and IEEE C57.152-2013.

Moisture assessment in IDAX is based on an average of several standards/reports.



Guidelines for assessing moisture content (by weight in solid insulation) in power transformers.

- 1) Original data in IEC 60422, annex A, are presented as relative saturation in percentage. "Dry," "Moderately wet," "Wet" and "Extremely wet" are recalculated to percent moisture in cellulose. Original data in IEC 60422 for new transformers is presented as percent moisture in cellulose insulation.
- 2) Original data in CIGRE TB 349 is by categories. "Good," "Fair," "Probably wet" and "Wet" are relabelled to "Good/New," "Dry" and "Wet."

High Interference suppression

Electrical interference in substation environment comes from various sources e.g.

- Induced AC (50/60Hz)
- Induced DC (corona discharge)
- DC interference in e.g. HVDC substations

The levels are often significant and may cause large measurement errors if not handled correctly. IDAX can handle up to 1 mA interference and with the VAX020 high-voltage amplifier up to 10 mA at 1:10 signal to noise ratio. This secures reliable DFR measurements under the most severe interference conditions.

Using true frequency domain measurements for dielectric response has major advantages:

- High AC (power frequency) interference suppression capacity
- High DC and VLF interference suppression capacity
- No concerns for long-time discharge of test object between measurements

All IDAX instruments are performing DFR measurements by using AC test signals in combination with state-of-the-art signal processing and digital filtering technique for reliable results in live substation environments with high interference.

Before starting a test, IDAX checks the measurement setup to verify that all cables are connected correctly. It also measures the actual AC and DC interference and adapt measurements settings for optimum performance.



✓ Meets international standards

Test setup, analysis model and insulation assessment according to international standards and guides

✓ Reliable and accurate

The DFR/FDS method has been validated for more than 10 years and is included in international standards and guides for transformer diagnostics

Specifications

Technical specifications

Environmental

<i>Application field</i>	The instrument is intended for use in medium and high-voltage substations and industrial environments.
<i>Ambient temperature</i>	
<i>Operating</i>	IDAX300: -20°C to +55°C (-4°F to +131°F) IDAX350: -10°C to +55°C (14°F to +131°F)
<i>Storage</i>	-40°C to 70°C (-40°F to +158°F)
<i>Humidity</i>	< 95%RH, non-condensing

CE-marking

<i>EMC</i>	2004/108/EC
<i>LVD</i>	2006/95/EC

General

<i>Mains voltage</i>	100 – 240V ±10%, 50/60 Hz
<i>Power consumption</i>	250 VA (max)
<i>Dimensions</i>	
<i>IDAX 300</i>	335 x 300 x 99 mm (13.2" x 11.8" x 3.9")
<i>IDAX 300 Flight case</i>	725 x 500 x 300 mm (25.5" x 19.7" x 11.8")
<i>IDAX 350</i>	520 x 430 x 220 mm (20.5" x 16.9" x 8.7")
<i>Weight</i>	
<i>IDAX 300</i>	4.9 kg (11 lbs) instrument 23.6 kg (52 lbs) incl. flight case and accessories
<i>IDAX 350</i>	13.5 kg (29.8 lbs)
<i>Accessories</i>	8.5 kg (18 lbs)

Measurement section

<i>Inputs</i>	3-ch, (Red, Blue and Ground)
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Tan delta and capacitance measurements

<i>Capacitance range</i>	10 pF – 100 µF
<i>Accuracy</i>	0.5% + 1 pF
<i>Dissipation factor range</i>	0 - 10 (with retained accuracy of capacitance; otherwise higher)
<i>Accuracy</i>	< 0.5% + 0.0001, 45-70 Hz, C > 100 pF (with VAX020) 0.5% + 0.0002, 45-70 Hz, C > 300 pF 1% + 0.0003, 1 mHz-100 Hz, C > 1000pF 2% + 0.0005, 100 Hz-1 kHz, C > 1000 pF
<i>Max AC interference</i>	1 mA, 1:10 SNR (IDAX) 10mA, 1:10 SNR (VAX020)
<i>Max DC interference</i>	2 µA (IDAX) 20 µA (VAX020)
<i>Test modes*</i>	UST: Ungrounded Specimen Testing UST-R: UST: Measure Red, Ground Blue UST-B: UST: Measure Blue, Ground Red UST-RB: UST: Measure Red and Blue GST: Grounded Specimen Testing GST-GND: GST: Ground Red and Blue GSTg-R: GST: Guard Red, Ground Blue GSTg-B: GST: Guard Blue, Ground Red GSTg-RB: GST: Guard Red and Blue *All IDAX instruments measure on red, blue and ground. Individually, in sequence or two at the same time for models with two ammeters.

DC insulation measurement (Time domain current measurement)

<i>Range</i>	50 mA
<i>Resolution</i>	0.1 pA
<i>Accuracy</i>	0.5% ±1 pA
<i>Input resistance (DC mode)</i>	≤10 kΩ

Outputs

GENERATOR

<i>Voltage/current ranges, 10 V</i>	0 – 10 Vpeak 0 – 50 mA peak
<i>Voltage/current ranges, 200 V</i>	0 – 200 Vpeak 0 – 50 mA peak
<i>Frequency range</i>	DC – 10 kHz

EXTERNAL

With VAX020 – High Voltage Amplifier

<i>Voltage/current ranges</i>	0 –2 kV peak 0 – 50 mA peak
<i>Frequency range</i>	DC – 1 kHz

PC Requirements

<i>Operating system</i>	Windows 2000/ XP / Vista / 7 /8
<i>Processor</i>	Pentium 500 MHz
<i>Memory</i>	512 Mb RAM or more
<i>Interface</i>	USB 2.0 and LAN

Calibration

<i>Calibration</i>	Calibration kit allows field calibration
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Ordering

Ordering information

Item	Art. No.
IDAX 300 Three channels with one (1) ammeter	AG-19090
IDAX 300S Three channels with two (2) ammeters	AG-19092
IDAX 350 Three channels with two (2) ammeters and internal computer	AG-19192
Included accessories	
Mains cable	
Ground cable 5 m (16 ft), GC-30060	
Generator cable 18 m (60 ft), GC-30312	
Measurement cable, red 18 m (60 ft), GC-30326	
Measurement cable, blue 18 m (60 ft), GC-30336	
USB cable, GA-30030	
Ethernet cable, GA-00985 (IDAX 300S)	
Windows software, AG-8100X	
Transport case (IDAX 300S), GD-30090	
Soft case for cable (IDAX 350) GD-00360	
User's manual	
Optional accessories	
VAX020 with accessories	AF-59090
Accessory kit	AG-90100
Mini bushing tap	
Hot collar straps	
Digital temp & humidity meter	
Bushing tap connector 0.75"	
Bushing tap connector 1.0"	
J probe bushing tap connector	
Shorting lead, non insulated, 1 m (3 ft)	
Shorting lead, non insulated, 2 m (6 ft)	
Bushing adapter ABB GOB (old type)	
Bushing adapter ABB GOB (new type)	
IDAX calibration box CAL 300	AG-90010
Oil test cell	670511
IDB 300, IDAX demo and training box	AG-90020
2nd ammeter option (factory upgrade to IDAX 300S)	AG-90200
Generator cable, 9 m (30 ft)	GC-30310
Measurement cable, 9 m (30 ft), red	GC-30324
Measurement cable, 9 m (30 ft), blue	GC-30334

Included accessories



Generator cable, USB cable, ground cable and measurement cables. Power cable and Ethernet cable not shown.



Rugged carrying case with wheels and space for cables and accessories (IDAX 300). Accessories for IDAX 350 delivered in a soft case.

Optional accessories



VAX020, high-voltage amplifier 0 to 2 kV (peak).



The optional accessory kit, AG-90100



The calibration box CAL300 enables simple and reliable calibration of the IDAX system. The calibration box is the only part that needs to be sent in for calibration to any local certified calibration facility.



Oil test cell



IDB 300 for IDAX demo and training

Your "One Stop" Source for all your electrical test equipment needs

- Battery Test Equipment
- Cable Fault Locating Equipment
- Circuit Breaker Test Equipment
- Data Communications Test Equipment
- Fiber Optic Test Equipment
- Ground Resistance Test Equipment
- Insulation Power Factor (C&DF) Test Equipment
- Insulation Resistance Test Equipment
- Line Testing Equipment
- Low Resistance Ohmmeters
- Motor & Phase Rotation Test Equipment
- Multimeters
- Oil Test Equipment
- Portable Appliance & Tool Testers
- Power Quality Instruments
- Recloser Test Equipment
- Relay Test Equipment
- T1 Network Test Equipment
- Tachometers & Speed Measuring Instruments
- TDR Test Equipment
- Transformer Test Equipment
- Transmission Impairment Test Equipment
- Watthour Meter Test Equipment
- STATES® Terminal Blocks & Test Switches
- Professional Hands-On Technical and Safety Training Programs

Megger is a leading global manufacturer and supplier of test and measurement instruments used within the electric power, building wiring and telecommunication industries.

With research, engineering and manufacturing facilities in the USA, UK, Germany and Sweden, combined with sales and technical support in most countries, Megger is uniquely placed to meet the needs of its customers worldwide.

Megger is certified according to ISO 9001 and 14001. Megger is a registered trademark.

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